Plasma Edge and Plasma/Material Interaction Modeling Group

Purpose

Undertake model integration and studies of the plasma edge and plasma/material interactions (PMI) that lead to:

1) fundamental understanding of the influences of plasma facing surfaces on fusion plasma performance

2) identifying performance limits and optimization strategies for advanced liquid and solid, first wall and PFC concepts.

Near Term Goal

Support the ALPS and APEX programs to help determine the feasibility of and optimization strategies for advanced first wall and PFC concepts.

Group Members

J. Brooks (ANL) – Chairman
T. Evans (GA)
A. Hassanein (ANL)
L. Owen (ORNL)
M. Rensink (LLNL)
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Current Tasks

Task 1. Support NSTX liquid surface module proposal via analysis of scrape off layer (sol) plasma with hydrogen-absorbing surface, lithium sputtering and transport, hydrogen, helium recycling characteristics, and related issues. (LLNL, ANL, GA, ORNL, UCSD, UIUC)

Task 2: Conduct plasma fluid code analysis (UEDGE code) of tokamak fusion reactor and FRC reactor sol with liquid *wall* (APEX designs). Estimate maximum permissible wall-temperature/wall-impurity-flux based on global plasma core plasma impurity limits and sol radiation limits. For tin, tin-lithium (tokamak), lithium etc. (FRC). (LLNL)

Task 3: Conduct plasma fluid code analysis (UEDGE code) of tokamak fusion reactor scrape off layer (SOL) with liquid *divertor*. (ALPS-ARIES design). Obtain initial hydrogen edge plasmas and later couple to the divertor impurity source from Task 3. Using combined UEDGE/REDEP analysis estimate sputtered impurity concentration in SOL. For lithium, tin (gallium). (LLNL, ANL)

Task 4: Conduct erosion/redeposition analysis (REDEP code package) of liquid surface fusion reactor divertor (ALPS-ARIES design). Via coordination with Task 2 analysis, estimate maximum allowable near-surface plasma temperature based on self-sputtering limits. Estimate core plasma contamination from sputtering. Use ALPS/APEX developed data and code estimates of sputtering yields. For lithium, tin, gallium. (ANL, LLNL, UIUC, SNL,GA)

Task 5. Support CDX-U (lithium) and DIII-D/DiMES (lithium, tin, etc.) experiments:

a) **Conduct b2.5 and/or UEDGE analysis of DiMES background/SOL plasma parameters (ORNL,LLNL, GA).**
b) **Estimate—to the extent possible from data and parametric modeling—near-surface plasma parameters for CDX-U (PPPL, ORNL, UCSD)**
c) **Using above plasma parameter estimates (and DIII-D near-surface data) conduct REDEP and related code analysis of impurity sputtering and transport in DIII-D and CDX-U (ANL, UIUC, GA)**
d) **Compare code predictions to data, and benchmark codes. (all)**

Task 6. Model particle fluxes (D-T, He) to and entrainment in liquid surfaces. Compare predictions with available test data. (ANL, LLNL, UCSD, SNL)

Task 7. Model the effects of ELMs on loss of material from liquid surfaces. Compare predictions with available test data. (ANL, GA, UCSD, SNL)

Task 8. Compute evaporation-limited surface temperature. limits for divertor liquid surfaces based on BPHI-3D sheath kinetic code analysis. For lithium, tin, gallium (ANL)

Task 9. Coordinate and provide up-date on atomic physics data/models. (GA)